

Patent Claims

1. Plant cell which is genetically modified, the genetic modification
leading to the reduction of the activity of one or more SSIII proteins
5 occurring endogenously in the plant cell and to the reduction of the
activity of one or more BEI proteins which occur endogenously in the
plant cell and to the reduction of the activity of one or more BEII
proteins which occur endogenously in the plant cell in comparison to
corresponding plant cells, of wild-type plants, which have not been
10 genetically modified.
2. Plant cell according to Claim 1, wherein the genetic modification is the
introduction of one or more foreign nucleic acid molecules whose
presence and/or expression leads to the reduction of the activity of one
15 or more SSIII and BEI and BEII proteins occurring in the plant cell in
comparison with corresponding plant cells, of wild-type plants, which
have not been genetically modified.
3. Transgenic plant cells according to Claim 2, wherein said foreign
20 nucleic acid molecules are selected from the group consisting of
 - a) DNA molecules encoding at least one antisense RNA which brings
about a reduction of the expression of at least one endogenous
gene encoding SSIII proteins and/or BEI proteins and/or BEII
proteins;
 - 25 b) DNA molecules which, via a cosuppression effect, lead to a
reduction of the expression of at least one endogenous gene
encoding SSIII protein(s) and/or BEI protein(s) and/or BEII
protein(s);
 - c) DNA molecules encoding at least one ribozyme which specifically
30 cleaves transcripts of at least one endogenous gene encoding SSIII
proteins and/or BEI proteins and/or BEII proteins; and

- 5 d) Nucleic acid molecules introduced by means of in-vivo mutagenesis which lead to a mutation or insertion of a heterologous sequence in at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), the mutation or insertion bringing about a reduction of the expression of at least one gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), or resulting in the synthesis of inactive SSIII and/or BEI and/or BEII proteins;
- 10 e) DNA molecules which simultaneously encode at least one antisense RNA and at least one sense RNA, where said antisense RNA and said sense RNA form a double-stranded RNA molecule which brings about a reduction of the expression of at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s);
- 15 f) DNA molecules containing transposons, the integration of the transposon sequences leading to a mutation or an insertion in at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s) which brings about a reduction of the expression of at least one gene encoding an SSIII protein(s) and/or BEI protein(w) and/or BEII protein(s), or which results in the synthesis of inactive SSIII and/or BEI and/or BEII proteins; and/or
- 20 g) T-DNA molecules which, owing to the insertion into at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), bring about a reduction of the expression of at least one gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), or which result in the synthesis of inactive SSIII and/or BEI and/or BEII proteins.
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- 30 4. Plant cell according to one of Claims 1 to 3, which synthesizes a modified starch in comparison with a wild-type plant cell which has not been genetically modified.

5. Plant cell according to Claim 4, wherein the modified starch is characterized in that
- a) it has an amylose content of at least 30%,
 - 5 b) it has an increased phosphate content in comparison with starch from corresponding wild-type plant cells which have not been genetically modified, and
 - c) it has an increased final viscosity in the RVA analysis in comparison with wild-type plant cells which have not been genetically modified.
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6. Plant cell according to Claim 4 or 5, wherein the modified starch is characterized in that it has an increased gel strength in comparison with starch from wild-type plant cells which have not been genetically modified.
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7. Plant cell according to one of Claims 4 to 6, wherein the modified starch is characterized in that it has a modified side chain distribution and/or a modified starch granule morphology in comparison with starch from wild-type plant cells which have not been genetically modified.
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8. Plant containing plant cells according to one of Claims 1 to 7.
9. Method for generating a plant cell which synthesizes a modified starch, comprising the genetic modification of the plant cell, the genetic
- 25 modification leading to the reduction of the activity of one or more SSIII proteins which occur endogenously in the plant cell and to the reduction of the activity of one or more BEI proteins which occur endogenously in the plant cell and to the reduction of the activity of one or more BEII proteins which occur endogenously in the plant cell, in
- 30 comparison with corresponding plant cells, of wild-type plants, which have not been genetically modified.

10. Method for generating a plant cell according to Claim 9 which synthesizes a modified starch, wherein the plant cell is genetically modified by the introduction of one or more foreign nucleic acid molecules whose presence and/or expression leads to the reduction of the activity of in each case at least one SSIII, BEI and BEII protein in comparison with corresponding wild-type plant cells which have not been genetically modified.
11. Method according to Claim 9 or 10, wherein the modified starch is characterized in that
- a) it has an amylose content of at least 30%,
 - b) it has an increased phosphate content in comparison with starch from corresponding wild-type plant cells which have not been genetically modified, and
 - c) it has an increased final viscosity in the RVA analysis in comparison with starch from corresponding wild-type plant cells which have not been genetically modified.
12. Method for generating a genetically modified plant, in which
- a) a plant cell according to one of Claims 9 to 11 is generated;
 - b) a plant is regenerated from, or using, the plant cell generated in accordance with a); and,
 - c) if appropriate, further plants are generated from the plant generated in accordance with step b).
13. Method for generating a transgenic plant according to Claim 12 which synthesizes a modified starch, in which
- a) a plant cell is genetically modified by the introduction of one or more foreign nucleic acid molecules whose presence and/or expression leads to the reduction of the activity of in each case at least one SSIII,

BEI and BEII protein in comparison with corresponding wild-type plant cells which have not been genetically modified;

- b) a plant is regenerated from, or using, the cell generated in accordance with a); and
- 5 c) if appropriate, further plants are generated from the plants generated in accordance with step b).

14. Method according to Claim 12 or 13, wherein the modified starch is characterized in that

- 10 a) it has an amylose content of at least 30%,
- b) it has an increased phosphate content in comparison with starch from corresponding wild-type plant cells which have not been genetically modified, and
- 15 c) it has an increased final viscosity in the RVA analysis in comparison with starch from corresponding wild-type plants which have not been genetically modified.

15. Plant according to Claim 8 or obtainable by the method according to one of Claims 12 to 14, which is a starch-storing plant.

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16. Plant according to Claim 15, which is a potato plant.

17. Propagation material of plants according to one of Claims 8 or 15 to 16 containing at least one plant cell according to one of Claims 1 to 7.

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18. Use of one or more nucleic acid molecules which encode proteins with the enzymatic activity of at least one SSIII, at least one BEI and/or at least one BEII protein or their fragments for the generation of plant cells according to one of Claims 1 to 7 or of plants according to one of
30 Claims 8 or 15 to 16.

19. Use of one or more nucleic acid molecules for the generation of plant cells according to one of Claims 1 to 7 or of plants according to one of Claims 8 or 15 to 16, wherein the foreign nucleic acid molecule(s) are selected from the group consisting of:

- 5 a) DNA molecules encoding at least one antisense RNA which brings about a reduction of the expression of at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s);
- 10 b) DNA molecules which, via a cosuppression effect, lead to a reduction of the expression of at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s);
- 15 c) DNA molecules encoding at least one ribozyme which specifically cleaves transcripts of at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s);
- 20 d) Nucleic acid molecules introduced by means of in-vivo mutagenesis which lead to a mutation or insertion of a heterologous sequence in at least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), the mutation or insertion bringing about a reduction of the expression of at least one gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), or resulting in the synthesis of inactive SSIII and/or BEI and/or BEII proteins;
- 25 e) DNA molecules which simultaneously encode at least one antisense RNA and at least one sense RNA, where said antisense RNA and said sense RNA form a double-stranded RNA molecule which brings about a reduction of the expression of at least one endogenous gene encoding SSIII proteins and/or BEI proteins and/or BEII proteins;
- 30 f) DNA molecules containing transposons, the integration of the transposon sequences leading to a mutation or an insertion in at

least one endogenous gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s) which brings about a reduction of the expression of at least one gene encoding an SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), or which result in the synthesis of inactive SSIII and/or BEI and/or BEII proteins; and

5 g) T-DNA molecules which, owing to the insertion into at least one endogenous gene encoding SSIII proteins and/or BEI proteins and/or BEII proteins, bring about a reduction of the expression of at least one gene encoding SSIII protein(s) and/or BEI protein(s) and/or BEII protein(s), or which result in the synthesis of inactive

10 SSIII and/or BEI and/or BEII proteins.

20. Composition comprising at least one of the nucleic acid molecules defined in Claim 19, where the at least one nucleic acid molecule, after

15 introduction into a plant cell, leads to the reduction of at least one SSIII protein which occurs endogenously in the plant cell and at least one BEII protein which occurs endogenously in the plant cell and preferably furthermore to the reduction of at least one BEI protein which occurs endogenously in the plant cell.

20 21. Composition according to Claim 20, characterized in that the presence of the at least one nucleic acid molecule in said plant cells leads to a reduction of the activity of in each case at least one SSIII and BEI and BEII protein in comparison with corresponding wild-type plant cells

25 which have not been genetically modified.

22. Composition according to one of Claims 20 to 21, the nucleic acid molecules being present in a recombinant nucleic acid molecule.

30 23. Use of a composition according to one of Claims 20 to 22, or containing at least one of the nucleic acid molecules defined in Claim

19, for generating a plant cell with a reduced activity of one or more SSIII proteins which occur endogenously in the plant cell and a reduced activity of one or more BEI proteins which occur endogenously in the plant cell and a reduced activity of one or more BEII proteins which occur endogenously in the plant cell, in comparison with corresponding plant cells, of wild-type plants, which have not been genetically modified.

24. Transformation system for plant cells containing at least one nucleic acid molecule and at least one plant cell, the at least one nucleic acid molecule leading to the reduction of the activity of in each case at least one of the SSIII, BEI and BEII proteins which occur endogenously in the plant cell unless the activity of these proteins has been reduced already by an existing genetic modification of said plant cell.

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25. Host cell containing a composition according to one of Claims 20 to 22.

26. Host cell according to Claim 25, which is a transgenic plant cell containing the composition according to one of Claims 20 to 22.

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27. Starch which can be obtained from plant cells according to one of Claims 1 to 7 or 26 or from a plant according to one of Claims 8 or 15 to 16 or from propagation material according to Claim 17.

25 28. Starch according to Claim 27, characterized in that

a) it contains amylose content of at least 30%,

b) it has an increased phosphate content in comparison with starch from

corresponding wild-type plant cells which have not been genetically modified, and

- c) it has an increased final viscosity in the RVA analysis in comparison with starch from corresponding wild-type plants which have not been genetically modified.

5 29. Starch according to Claim 27 or 28, characterized in that it has a modified side chain distribution in comparison with starch from corresponding wild-type plant cells which have not been genetically modified.

10 30. Starch according to one of Claims 27 to 29, characterized in that the granule morphology and/or the mean granule size of the starch granules are modified in comparison with wild-type plant cells which have not been genetically modified.

15 31. Starch according to one of Claims 27 to 30, which is a potato starch.

32. Method for producing a starch according to one of Claims 27 to 31, comprising the extraction of the starch from a plant according to one of Claims 8 or 15 to 16 and/or from starch-storing parts of such a plant
20 and/or from a plant cell according to one of Claims 1 to 7 or 26 and/or from propagation material according to Claim 17.

33. Starch according to one of Claims 27 to 31, obtainable by a method according to Claim 32.

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34. Starch according to one of Claims 27 to 31 or 33, characterized in that it has at least one of the following characteristics:

a) a final viscosity in the RVA analysis of a 6% (w/w) aqueous starch
suspension of at least 300 RVU, preferably at least 400 RVU, in
30 particular at least 500 RVU;

- b) a phosphate content in the C6 position of the glucose monomers of the starch of 40 to 120 nmol, preferably 60 to 100 nmol, in particular 80 to 100 nmol of C6-P per mg of starch;
- c) a porous surface of the starch granules in native form.

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35. Processing product, in particular foodstuffs or feedstuffs, colour, adhesive, building or insulating material, containing a starch according to one of Claims 27 to 31, 33 or 34.

10 36. Starch-containing part of a plant according to one of Claims 8, 15 or 16.

37. Method for modifying the starch of a plant, comprising the method for generating a plant according to one of Claims 12 to 14 and obtaining
15 starch from the plant or starch-containing parts thereof.

38. Method according to Claim 37, characterized in that the modification of the starch comprises:

- a) increasing the amylose content of the starch;
- 20 b) increasing the phosphate content of the starch, in particular to a phosphate content in the C6-position of the glucose monomers of the starch of 40 to 120 nmol, preferably 60 to 100 nmol, in particular 80 to 100 nmol of C6-P per mg of starch;
- c) increasing the final viscosity of the starch, in particular to a final
25 viscosity in the RVA analysis with 6% (w/w) aqueous starch suspension of at least 300 RVU, preferably at least 400 RVU, in particular at least 500 RVU;
- d) increasing the gel strength of the gelatinized starch, and/or
- e) the morphology, in particular the surface structure, porosity and/or
30 granule size distribution of the native starch granules.